

ARCHITECTURE OF A STELLAR HOME

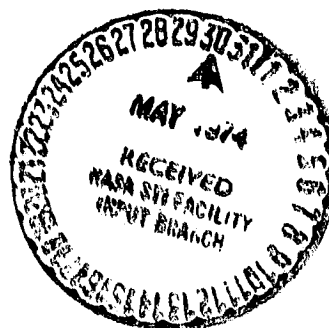
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Like the Earth, space has its anniversaries. Orbital docking of the "Soyuz-4" and "Soyuz-5" was accomplished exactly 5 years ago. The Soviet "Space Duo" made up the first manned orbital station in the history of cosmonautics. New launches followed. Docking was carried out for the purpose of delivering equipment to long-term orbital stations such as the "Salyut" and "Skylab". Their very first orbital trips made the question of increase in their dimensions and the problem of lengthening their service life matters of great topical interest. /3*

The following article discusses orbital stations of the immediate future.

Space construction may be carried out in various ways. At first it would appear to be the simplest to assemble a station on Earth and then put it into orbit around the Earth. However, this is far from the best method: it requires the construction of enormous carrier rockets and the procurement of extensive resources for their development and testing. In addition, in the event of an unsuccessful launch the entire large orbital station outfitted with complex and costly equipment may be ruined.

It is more advisable to assemble stations part by part in space, for the delivery of which use may be made of existing rockets. If necessary a missing unit which for some reason or other was not sent out the first time can easily be put into orbit. Assembly may then be started immediately. In this way a station of virtually any dimensions may be established.

What may the space stations of the future look like externally and internally? Apparently it is the most advisable to fashion the sections to be assembled in the form of spheres or cylinders. Shapes such as this yield the

*Numbers in the margin indicate pagination in the foreign text.

the lowest weight with the assigned volume and are convenient for orbital assembly and accommodation of equipment. We should note that such standardization does not imply uniformity: a station made up of standard units can be cylindrical, spherical, in the shape of dumbbells, or in the form of a hub with vanes.

Let us consider briefly the technology of assembly. First of all it is necessary to perfect the systems and operations for mutual location of two craft in orbits close to each other, maneuvering, approach, and docking. All these tasks can be performed both in the fully automatic mode and with the participation of a space crew. Mention may be made of the first fully automatic docking of unmanned spacecraft, the Soviet satellites "Kosmos-186" and "Kosmos-188". One of them was "active," and the other "passive." The former searched for the latter in space, and the latter served as a beacon for the "passive" one. The multistage propulsion systems necessary for maneuvering were installed aboard the craft. In addition, low-thrust jet engines were mounted on both satellites for precision docking.

Another way of establishing large stations, one involving the use of a space "tug", is also practicable along with the customary method. The tug would maneuver the next unit to be assembled in orbit and "tow" it to the assembly site. Then it would make a trip for a new section. If necessary, a space tug could be controlled by a cosmonaut. The advantages are obvious. The sections to be assembled would no longer need propulsion systems and automated equipment of their own.

Much has been written about the merits of inflated structures. Houses, warehouses, and sports complexes are far from representing a complete list of the structures for which use is beginning to be made of attractive light shells supported by air. This construction method is also promising for application in space. A special structure made of an elastic shell can be packed in a small compartment of a craft put into orbit. In orbit it could be opened out by means of compressed gas in cylinders and could assume virtually any shape imparted to such structures on Earth. A structure such as this represents a fairly good utility warehouse.

Scientists have already set concrete requirements for these space shells. First of all, the structures must possess a low permeability to gas and be very durable in collisions with micrometeorites. If holes are torn in it on occasion, the shell must not break. The shell could be repaired promptly by injecting a rapidly hardening compound into the hole that has been formed, or by other methods. Multilayer shells of high rigidity and durability may also be used.

Yet another example of such structures is a shell which is opened out in orbit by heating. The necessary heat is derived from chemical and electrical power sources or simply from the Sun. One structure which has been built consists of a special film and stiffeners of a titanium-nickel alloy. The frame has the property of "remembering" the shape it had on Earth at a high temperature before being packed.

Plastic metals will also be used in space. The structures made from them, in the form of bellows, can also be independent units.

The space stations of the future will obviously be designed for prolonged duty in orbit, not just for months but for years. Hence it is necessary to ensure them against all possible surprises, primarily damage by micrometeorites. A special shell placed in orbit in the form of a roll could provide a fairly good shield absorbing the impact of foreign bodies in space.

How many other assembly methods will in time be used in the creation of orbital stations? Scientists often turn to bionics and adopt structures observed in nature. For instance, these are acknowledged to be unsurpassed builders of their minute dwellings, beehives. Calculations show that the "beehive structure" is highly promising for the establishment of space platforms in orbit around the Earth. In orbit a beehive unit can be expanded like an accordion to the necessary dimensions.

Thus we already know how to build orbital stations. No one is worried about the dimensions of the future stations. The only concern is the number of shuttle trips by a space cargo ship delivering the necessary sections. But another problem immediately arises, that of outfitting the stellar platforms with enormous antennas and telescopes, ones of such dimensions that they cannot

be put into orbit even by the most powerful carrier rocket. Consider, for example, an antenna hundreds of meters long. Scientists believe that precisely such devices are needed in space for the conduct of much long-range research. Hence the unwieldy equipment will also have to be assembled in parts. And there are many original proposals for coping with this problem. The most attractive solution appears to be a modular antenna resembling a beehive, which can be assembled as is a prefabricated house.

K. E. Tsiolkovski, who foresaw the possibility of establishing colonies beyond the atmosphere, wrote that man will not remain on Earth forever; he will gradually penetrate beyond the limits of the atmosphere, and then will conquer the space around the Sun. The daring projects of this scientist are beginning to materialize. The orbital stellar complexes of the near future will represent a significant entry in the annals of the conquest of space.

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